

NorthWestern Energy and City of Bozeman Research and Development Solar Pilot Project

Background

- The growth of solar and the emergence of new technologies are changing electric utilities across the country.
- Variable and distributed renewable energy sources, such as solar photovoltaics, are expanding, especially in the Bozeman community.
- There are growing expectations for utilities to offer new sources of clean, yet intermittent energy sources. Offering variable and distributed sources of energy demands more out of our traditional grid. Distributed renewable energy introduces the need for greater interactivity of the grid as well as between customers and the utility.
- NorthWestern Energy is actively preparing for solar and other new technologies on the system, while remaining focused on providing affordable and reliable energy for all users.
- In partnership with the City of Bozeman, NorthWestern Energy is planning a solar project that will test utility-scale solar on the grid.
- During a jointly hosted City-NWE Sustainable Energy Workshop in June of 2015, NorthWestern Energy announced plans to invest \$3 Million dollars into sustainable energy pilot projects in their Montana service territory, with the first \$1 Million committed to the Bozeman area.
- As a whole, Gallatin County is a rapidly growing part of NorthWestern Energy's service territory and offers a relatively good solar resource.

Goals

- NorthWestern Energy's goal is to evaluate long-term sustainable models for the integration of renewable energy.
- The solar project will concurrently test several key areas, including: community solar, load peak shaving, load alignment, integration of solar to the grid, virtual-metering with data recording for residential and commercial customers, and evaluating the role of energy storage.
- Data from this project may be used explore renewable energy rate models to help inform future planning and investment, including rate models for community solar---which would give local residents an opportunity to purchase a share of the solar array and receive a credit for this generation on their monthly utility bill.

- The City's goals for this project is to help satisfy our commitments under the Mayors' Climate Protection Agreement (signed 2006) and under our adopted Municipal and Community Climate Action Plans (adopted in 2008 and 2011). Participating in this pilot project as a partner is our most promising opportunity to advance our renewable energy goals.
- Through this pilot, the City of Bozeman has an opportunity to participate in the shaping of our utility's long-term vision for distributed, renewable energy.

Project Description

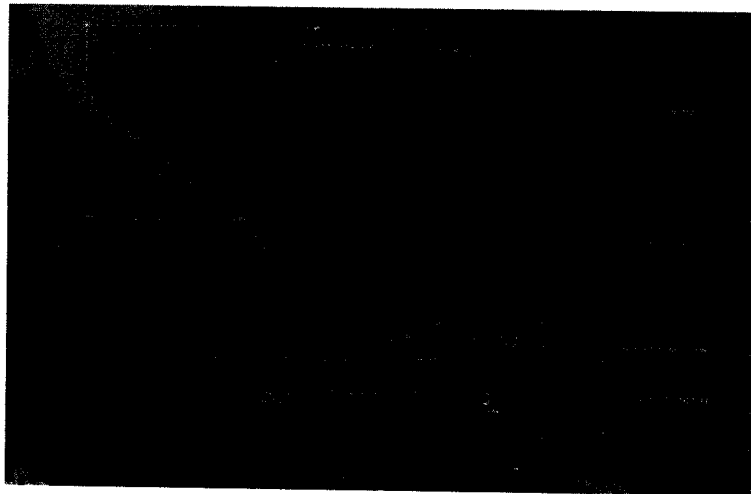
- This project is born out of a true partnership between the City of Bozeman and NorthWestern Energy. The City helped identify the land located at the Water Reclamation Facility as a potential project location.
- NorthWestern Energy will make the financial investment in the project, MSU has expressed interest to participate in the research, and the City will be asked to provide the land resource.
- The proposed project area includes 2.5 acres of land located on the southern edge of the Water Reclamation Facility, west of Moss Bridge Road (*map & project location to be displayed*). The size of the solar array is expected to be approximately 300kW, which would generate about 398,000 kWh per year, enough to meet the electricity demands of 38 homes.
- The land is not currently needed for water reclamation operations and could be put to greater use generating electricity that will be distributed to the grid. Data can be used to determine the financial and environmental benefits of renewable energy at the Water Reclamation Facility.

Bozeman Solar Project Updates:

The Bozeman Solar Project is on track and budget to meet a September 9th, 2016 completion date. NorthWestern Energy received 6 responses from the RFP posted on February 9th. With a review team consisting of the City Manager of Bozeman, Facility Manager of MSU, as well as NorthWestern Energy representation, interviews were held for the top three proposals. Onsite Energy was selected as the top Bidder. The contractor was executed on April 1st and a kickoff meeting was held on April 4th. Engineering and Geotechnical work starts April 6th. Press release will be issued on April 14th following a presentation to Bozeman Community on April 14th.

Total Contract Cost:	\$702,000
System Size (DC kW):	385.25 kW
System Size (AC kW):	336 KW
Modules:	QTY 1,150: Suniva 335 Watt Monocrystalline 72 Cell Solar Modules (American manufactured modules).
Expected Energy:	Year 1 Total = 533,198 kWhs
Inverter:	QTY 14: Fronius 24kW TL Inverters with Modbus Communication for SCADA controls and Web-Based monitoring provided by inverter manufacturer.
Monitoring:	Web-based monitoring consisting of: System Performance, System Availability (calculated from available data), Average and Accumulated Output, Voltage—DC and AC, Current—DC and AC, Capacity Factor (calculated from available data), Degradation (calculated from available data), Solar Irradiance, Module Temperature, Ambient Air Temperature, Wind Speed, Email Notifications for Service and Production Alerts
Racking:	RBI Solar solution with post driven ground mount and galvanized steel material. Solar modules shall be mounted in portrait orientation, grounded per UL standards, and have hardware mesh to meet NEC 690.31(a).

Design Overview:



Project Schedule:

Contract Executed	4/1/16
Project Start Date	4/4/16
Conceptual 40% Design Completed with NorthWestern Energy Input	4/15/16
SWPPP & Site Design Review Applications Submitted	4/25/16
75% Draft Construction Documents	4/29/16
NorthWestern Energy Comments 75% Draft Construction Documents	5/6/16
Engineering Complete with 100% Construction Drawings	5/20/16
Building & Electrical Plan Review Submitted	5/20/16
Product Submittals for Long Lead-Time Items	5/20/16
NorthWestern Energy approves 100% Construction Drawings & Product Submittals	5/27/16
Site Design Approval	6/7/16
Remaining Product Procurement	6/20/16
Building & Electric Permits Issued	6/20/16
Construction and Installation	6/27/16
Testing and Commissioning	8/22/16
Project Completed	9/9/16



NorthWestern Energy & City of Bozeman Bozeman Solar Project

May 13, 2016

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Agenda

- Background
- Project Benefits
- Project Overview
- Techie Stuff

Background



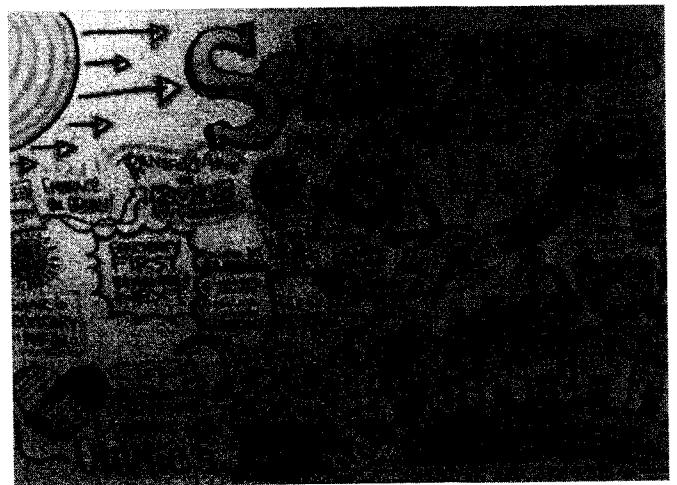
Background

Sustainable Energy Workshop

NorthWestern Energy, City of
Bozeman & Solar Electric Power
Association

85 stakeholders

\$3 Million investment for
renewable energy pilots, with
\$1 Million committed to
Bozeman



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Background

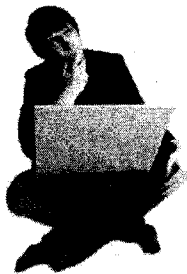
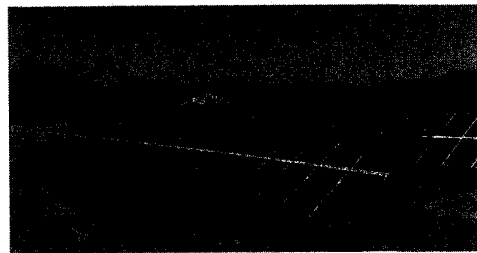
1. Interest and market for solar photovoltaics
2. Declining solar PV prices
3. Challenges and opportunities in grid integration
 1. Grid stability
 2. Load vs. PV production
 3. Fair long term models

**Safe and reliable
systems and service**



Partners

BOZEMAN^{MT}
City Sustainability



MONTANA
STATE UNIVERSITY



**SCHWEITZER
ENGINEERING
LABORATORIES**

(in progress)



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Bozeman Pilot Project

Evaluate long-term sustainable models for the integration of renewable energy to the grid



Pilot Project Technologies

- 385 KW Solar Array
- Smart Inverter Controls
- Enhanced metering

Gather Information

- Data
- System testing
- Costs and Benefits

Project Benefits



Benefits

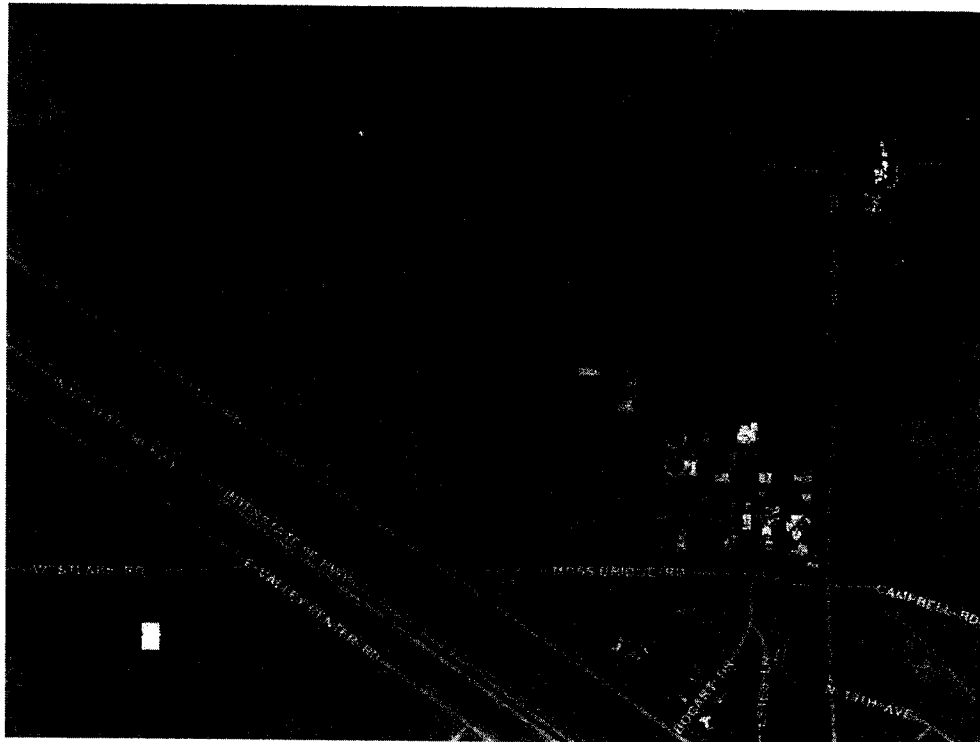
- 385 KW Solar Array
 - 533,000 kWh/yr
 - Enough to power 59 homes based on 750 kWh/month
- Data, Data, Data
 - Measure and Analyze and Quantify
 - Benefits of renewable energy on the distribution system.
 - Distribution improvements/added controls needed to maintain safe and reliable circuits.
 - Sustainable models for renewable energy
- Partnerships

High Level Overview



Proposed Project Location

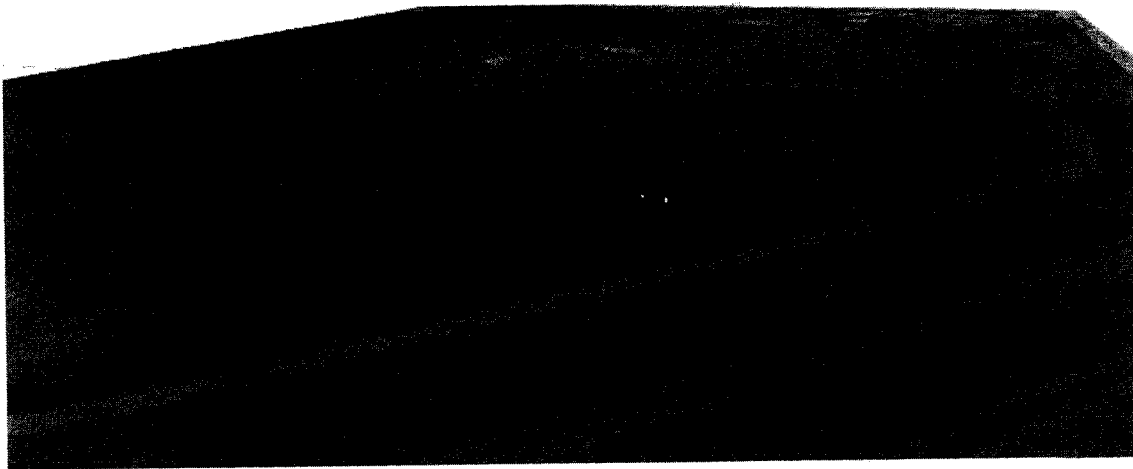
City of Bozeman Water Reclamation Facility



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Conceptual Layout



Operational in Sept. 2016

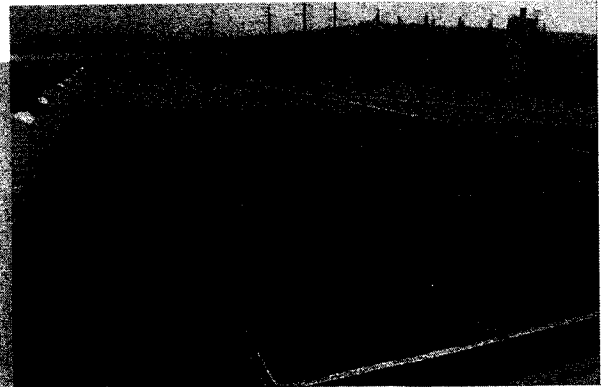
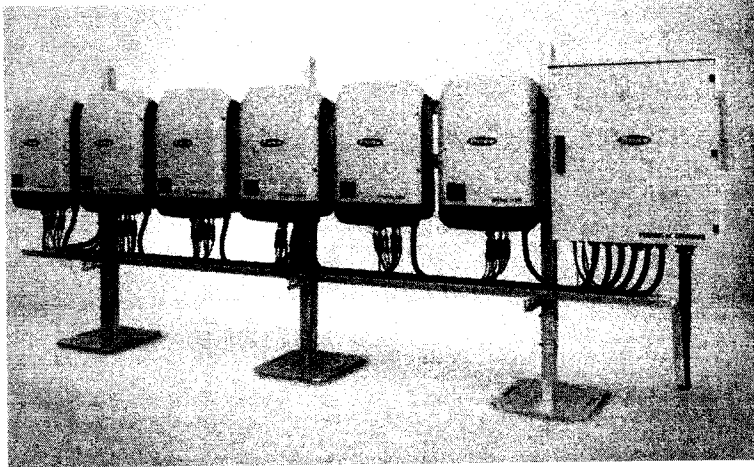


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System Info

- 1,150 – Suniva 335 Watt Monocrystalline panels
 - Manufactured in US
 - Technology derived Georgia Tech.
- 14 – 24KW Fronius inverters
 - Smart Inverter enabled





Who is building the project?

BOZEMAN^{MT}
The Great Northern Project

Partnership

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 **ONSITE ENERGY**
SOLAR ELECTRIC SERVICES

REDLEAF
CONSULTING



Water Rock



Meridian Land Survey, Inc.



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Techie Stuff

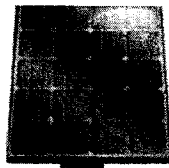
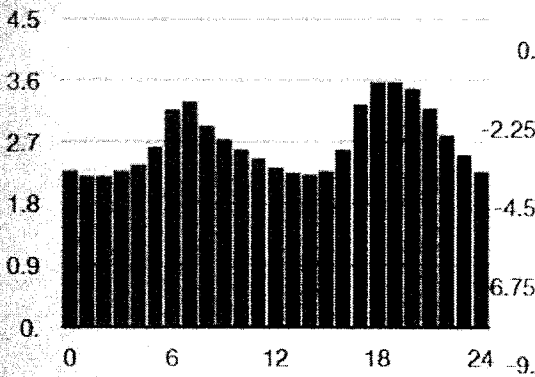
(A brief overview)



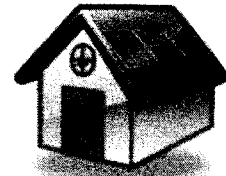
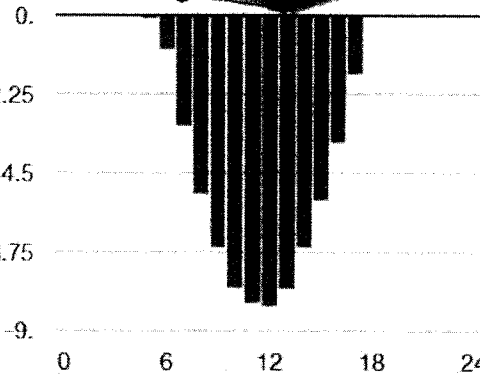
Solar Generation Profile



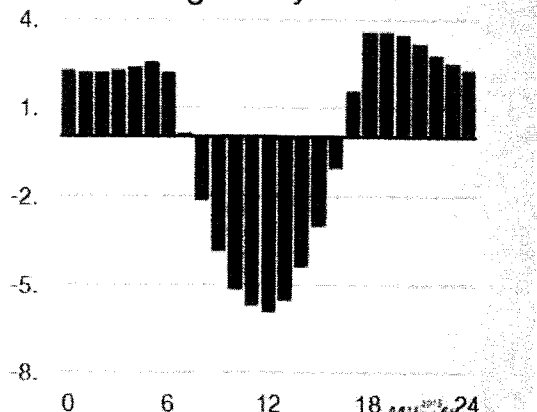
Average Daily Profile



Average Daily Profile



Average Daily Profile

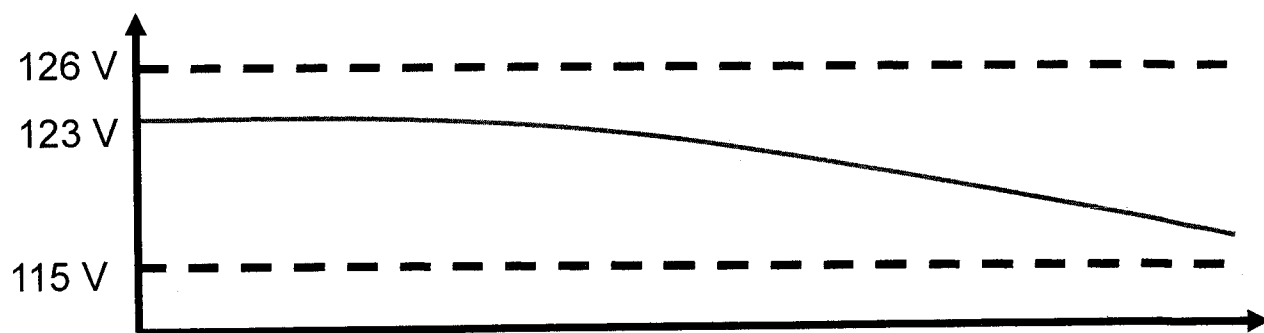
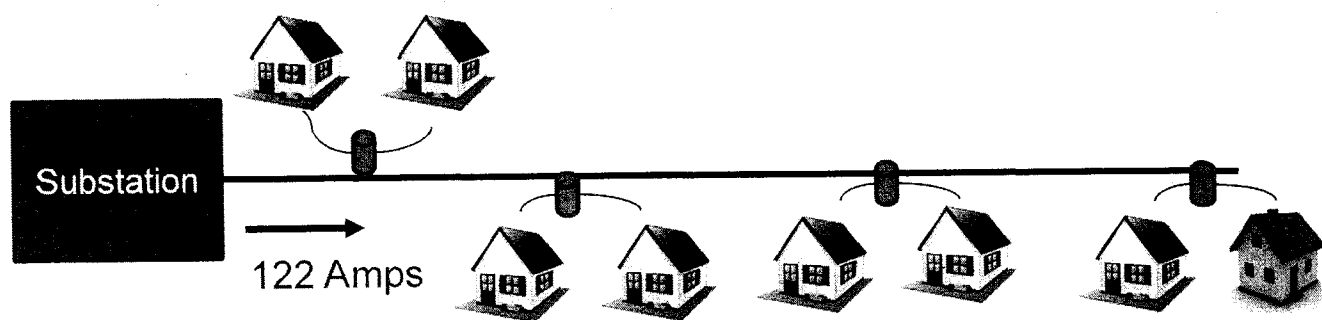


2015
Milsoft
Users Conference

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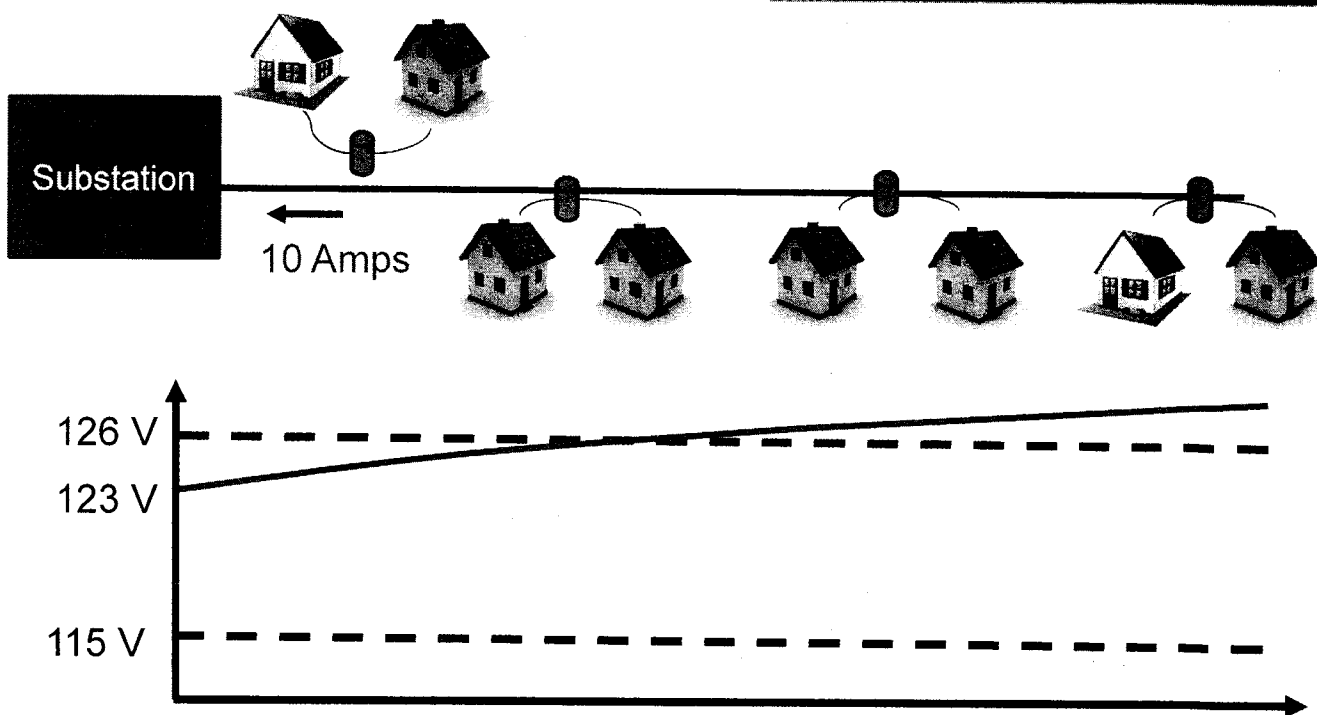


System with no solar



Voltage drop along a feeder ($V = I \cdot R$)

What happens with too much solar with no system improvements?



Voltage Rise Issues

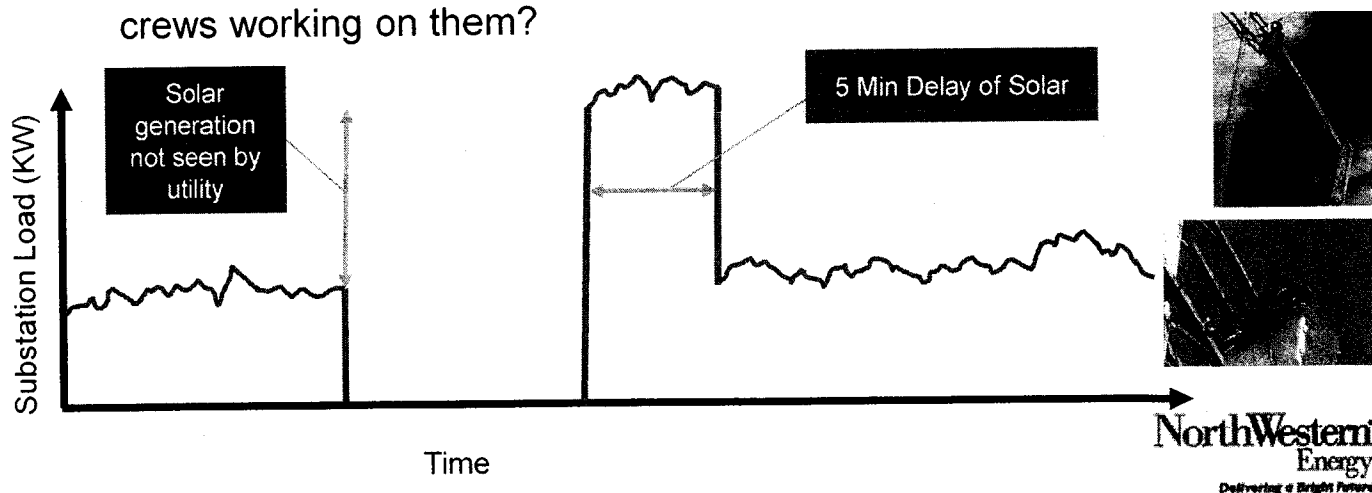
Equipment needs to be set up for reverse power flows. Not all substation controls have this capability. Requires communication and sensors.



Outage Situation

UL1741/IEEE 1547: Grid tied inverters take 5 minutes to sense voltage & frequency before reconnecting to the Utility.

1. What is the current flowing through the substation prior to an outage?
2. What about 30 seconds after an outage?
3. What if we are switching from one substation to another to bring on as many customers as possible (and the other substation is not upgraded with controls)?
 1. How do we keep our utility safe for both our customers and our crews working on them?

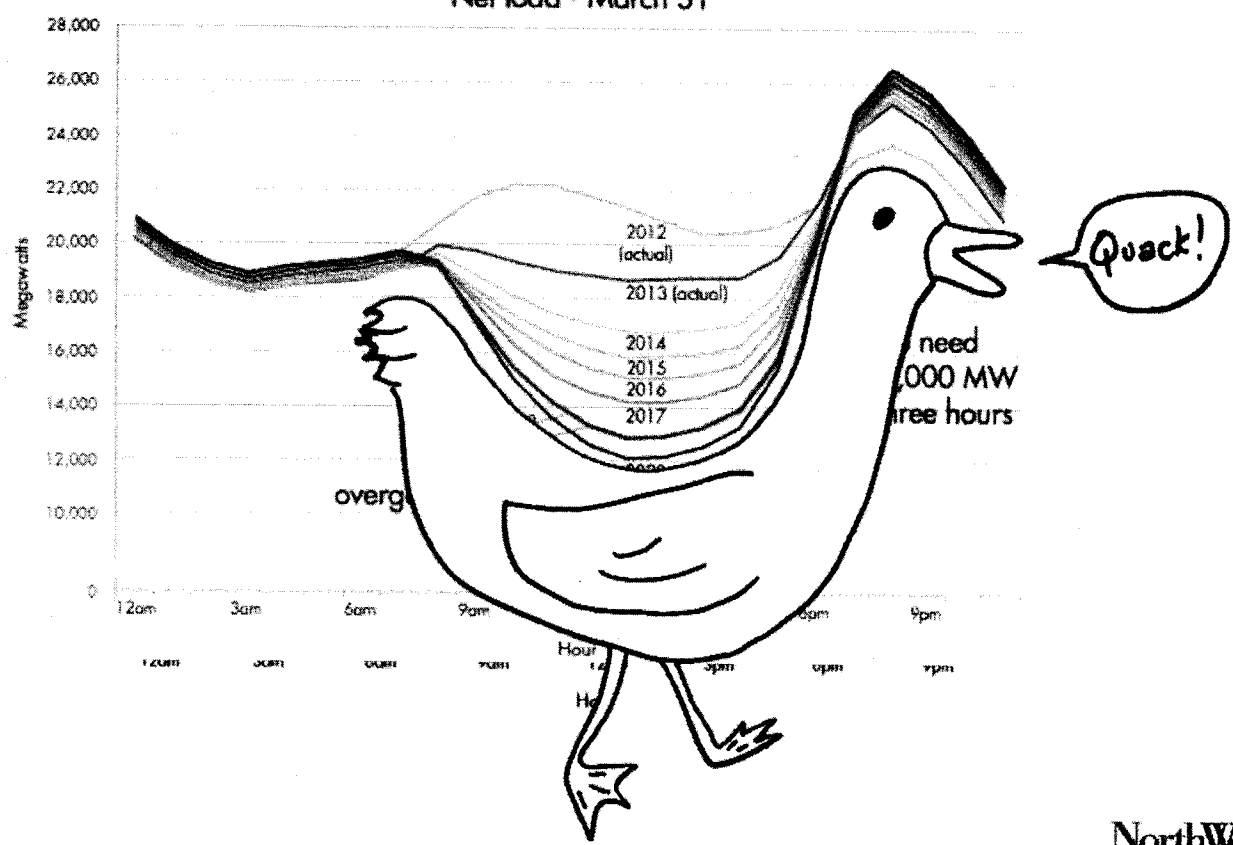




Duck What?

THE DUCK CURVE

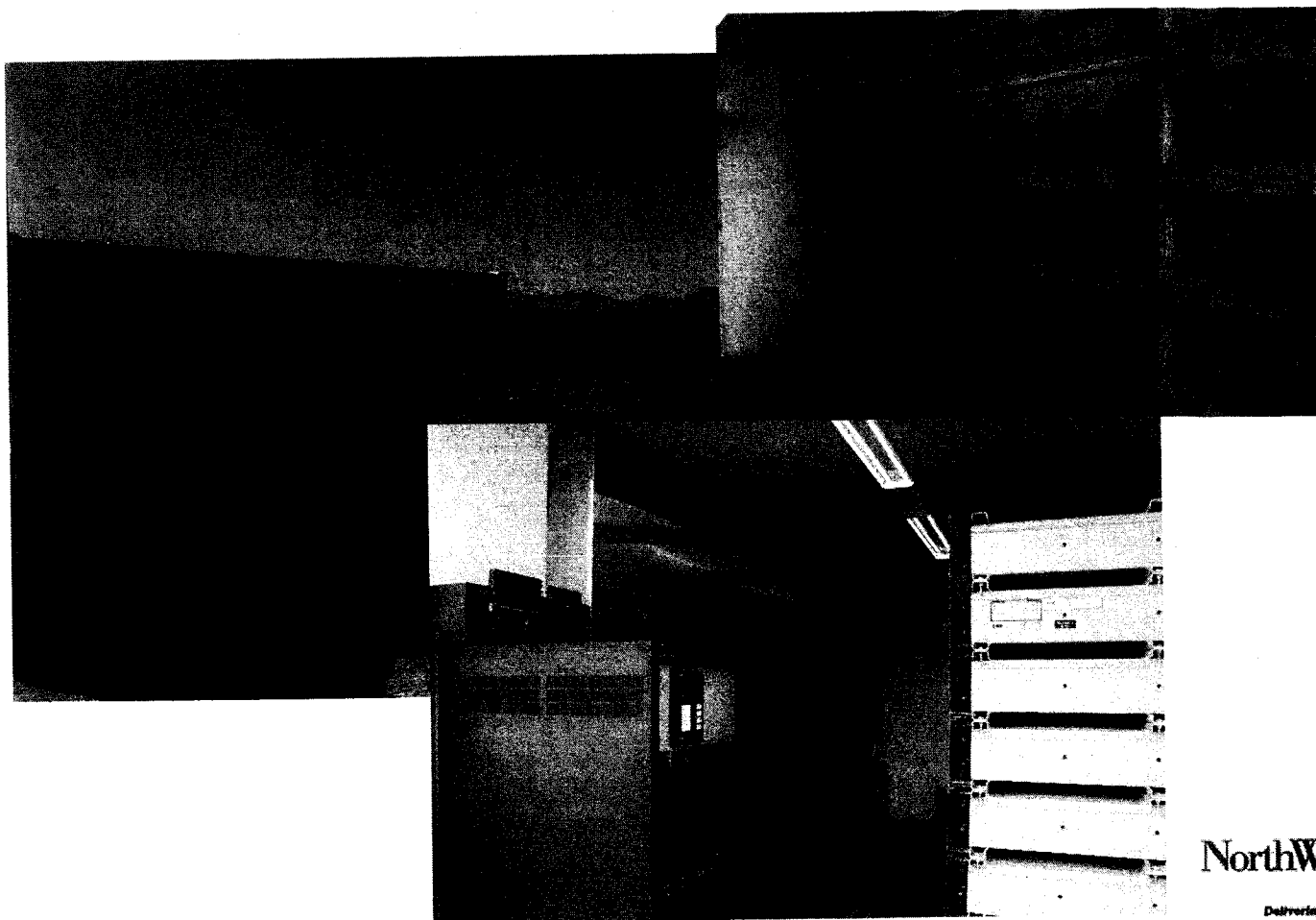
Net load - March 31



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Technology Brief – Energy Storage

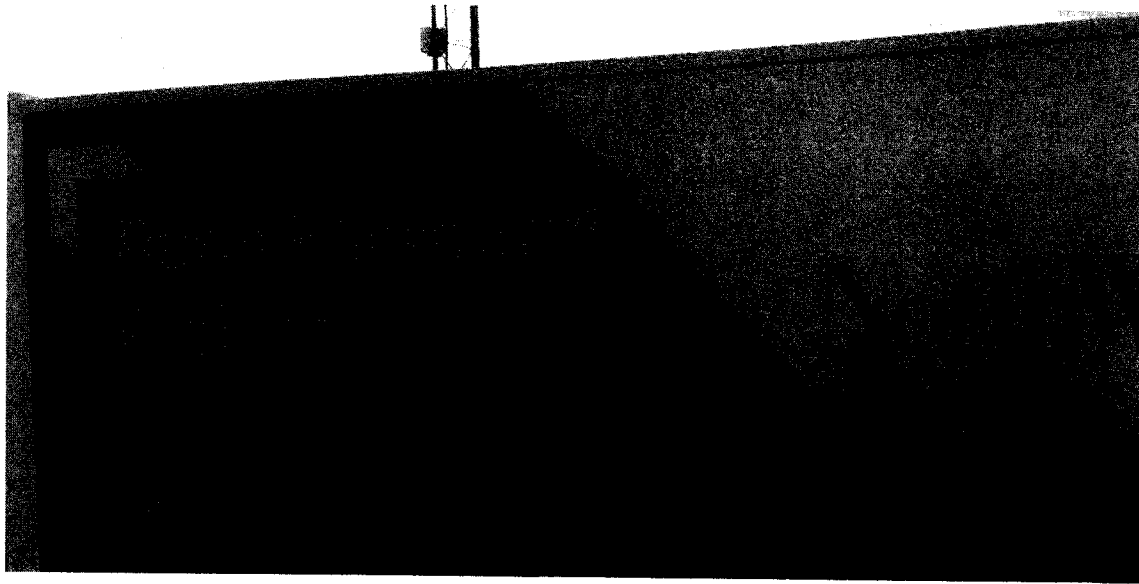


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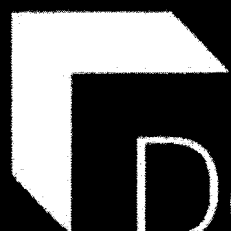


Partnerships

- Share data with partners to develop innovative & sustainable models for the long term growth of Solar.



Questions?



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